

Rejection of Claims under 35 U.S.C. § 102(b)

In the Office Action, claims 8, 14, 15, 17, and 25 stand rejected under 35 U.S.C. § 102(b) as being anticipated by U.S. Patent No. 5,720,901 (*De Jong et al.*). The Examiner states, with respect to claim 8, that *De Jong et al.* disclose a system comprising "a hydrocarbon, a hydrogen sulfide, and an oxygen injection line in communication with each other" and concludes that "[i]f they have to be mixed together, it is inherent that they are introduced separately." [Underlining added for emphasis.] Applicant respectfully traverses the Examiner's inherency proposition for the reason that *De Jong et al.* expressly contradict inherency. For example, *De Jong et al.* state that the necessary amount of sulfur-containing compound(s) may be present in the [natural] gas as it is produced from the reservoir (Col. 5, lines 11- 22). To support an anticipation rejection based on inherency, factual and technical grounds must be provided which establish that the inherent feature necessarily flows from the teachings of the reference. The mere probability or possibility of the feature at issue is insufficient. *Glaxo Inc. v. Novopharm Ltd.* 52 F.2d 1043, 34 U.S.P.Q. 2d 1565 (Fed. Cir. 1995). It is not inherent in the teachings of *De Jong et al.* that hydrocarbon, oxygen and the sulfur-containing compound are necessarily and inevitably introduced separately. Nevertheless, even if one were to disregard how the hydrocarbon, H₂S and oxygen are introduced by *De Jong et al.*, the reference still fails to teach a single reaction zone that includes a catalyst that is active for partially oxidizing both H₂S and light hydrocarbons to produce a product containing CO, H₂, elemental sulfur and water, among other differences.

The language of amended claim 8 now specifically recites at least one cooling zone located downstream of the reaction zone, and requires that the "at least one cooling zone" include a sulfur condenser that removes elemental sulfur from the product. Claim 14 has been canceled because its subject matter is now included in amended claim 8. Claim 15 has been amended to change its dependency to claim 8 instead of now-canceled claim 14, and to require that the tailgas processing unit(s) are downstream of the sulfur condenser. Claim 17 has been amended for the sole purpose of correcting an obvious typographical error in which "method" was inadvertently written instead of "system."

It is well established that in order to anticipate a claim, a single source must contain all the elements of the claim. See *Hybritech Inc. v. Monoclonal Antibodies, Inc.*, 802 F.2d 1371, 1379, 231 U.S.P.Q. 81, 90 (Fed. Cir. 1986). Missing elements may not be supplied by the knowledge of one skilled in the art or the disclosure of another reference. See *Structural Rubber Prods. Co. v.*

Park Rubber Co., 749 F.2d 707, 716, 223 U.S.P.Q. 1264, 1271 (Fed. Cir. 1984). *De Jong et al.* do not teach that elemental sulfur is produced in the same reactor along with syngas, and there is no sulfur condenser provided for removing elemental sulfur from the gaseous product emerging from heat exchanger 10. In fact, if the syngas is to be used in sulfur-sensitive applications, *De Jong et al.* rely solely on removal of sulfur-containing compounds from the cooled product stream 16 in a conventional manner such as:

"adsorption of the sulfur-containing compounds by passing the product stream through a bed of a suitable adsorbent, for example active carbon or zinc oxide."
(Col. 8, lines 24-27)

Therefore, because *De Jong et al.* is silent as to a condenser (as acknowledged by the Examiner at page 6, para. 8 of the Office Action) *De Jong et al.* clearly does not anticipate amended claim 8.

For at least these reasons, independent claim 8 and claims 9-12, 14-17, and 21-25 which depend directly or indirectly from, and add limitations to, claim 8 distinguish over *De Jong et al.* Even if, for the sake of argument, *De Jong et al.* did teach a mixing zone upstream from the reaction zone (as in claim 9), at least one cooling zone downstream from the reaction zone (as in original claim 14, now included in amended claim 8), a tailgas processing unit downstream from the cooling zone (as in amended claim 15), a catalyst containing rhodium (as in amended claim 17), and a sulfur absorbing material (as in amended claim 25), *De Jong et al.* would still fail to provide Applicant's invention as described in claims 8, 9, 14, 15, 17 and 25.

Rejection of Claims under 35 U.S.C. § 103(a)

In the Office Action, claims 9-12, 16, 21, 22, 24, 26-28 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over *De Jong et al.* in combination with various second references. In order to establish a *prima facie* case of obviousness, three criteria must be met: i) there must be some suggestion or motivation, either in the references themselves or in the knowledge generally available to one of ordinary skill in the art, to modify or to combine reference teachings; ii) there must be reasonable expectation of success; and iii) the prior art references must teach or suggest all the claim limitations. MPEP § 2143.

i) Suggestion or motivation to combine

With respect to the first criterion, there must be some suggestion or motivation to modify or combine the reference teachings. The mere fact that the references can be physically combined or modified does not render the resultant combination obvious unless the prior art also suggests the

desirability of the combination. Applicant asserts that there is no suggestion or motivation to combine the references, as discussed in detail below.

ii) Reasonable expectation of success

With respect to the second criterion, there must be some reasonable expectation of success. Because the references lack a suggestion or motivation to combine or modify, they also lack evidence suggesting that a combination or modification would be successful.

iii) Prior art references must teach or suggest all the claim limitations

With respect to the third criterion, the prior art references must teach or suggest all the claim limitations. Among other differences, *De Jong et al.* fail to teach a reaction zone containing a catalyst that is active for partially oxidizing H_2S to elemental sulfur and water, and fail to teach a sulfur condenser for the removal of elemental sulfur. As discussed in more detail below, merely picking and choosing various elements from unrelated structures using Applicant's disclosure as a guide does not amount to a teaching or suggestion of all the claim limitations in the cited references.

Claims 9, 11, and 12

In the Office Action, claims 9, 11, and 12 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over *De Jong et al.* in view of U.S. Patent No. 4,844,837 (*Heck et al.*). As discussed above, *De Jong et al.* do not teach the production of gaseous elemental sulfur and water along with CO , H_2 products, makes no provision for condensing or removing elemental sulfur, and does not include a sulfur condenser in their apparatus. This deficiency is not cured even if one were to combine the apparatus of *De Jong et al.* with the mixing zone upstream from the reaction zone, as taught by *Heck et al.* For at least this reason, claim 9 is nonobvious over *De Jong et al.* and *Heck et al.* Similarly, even if one were to include the oxygen line that communicates with the reaction zone, as described by *De Jong et al.* (Col. 7, lines 65-67), or the mixing zone that receives oxygen from the oxygen injection line (#6 and #4 in Fig.1), one would still not have the invention of Applicant's claims 11 and 12. Because the combined references do not provide the sulfur condenser of claim 8, from which claims 9, 11, and 12 depend, claims 9, 11, and 12 are all believed to be patentable over the references.

Claim 10

In the Office Action, claim 10 stands rejected under 35 U.S.C. § 103(a) as being unpatentable over *De Jong et al.* in view of U.S. Patent No. 5,472,920 (*Dubois et al.*). The Examiner suggests that it would be obvious to combine a thermal barrier as described in *Dubois et*

al. between the mixing and reaction zones in *De Jong et al.* In reply, Applicant respectfully submits that even if the thermal barrier of *Dubois et al.* were combined as proposed by the Examiner for the stated reasons, one still would not have the invention of claim 10 because *De Jong et al.* do not disclose the entire system of amended claim 8, as discussed above, from which claim 10 indirectly depends. The mere addition of a thermal barrier to the reactor of *De Jong et al.* would not correct the deficiencies of the resulting apparatus.

Claim 16

Claim 16 stands rejected under 35 U.S.C. § 103(a) as being unpatentable over *De Jong et al.* in view of U.S. Patent No. 5,654,491 (*Goetsch et al.*). The Examiner suggests that it would be obvious to provide a wire gauze as described in *Goetsch et al.* as a catalyst support for the catalyst in *De Jong et al.* Even if the wire gauze of *Goetsch et al.* were combined as proposed by the Examiner, one still would not have the invention of Applicant's claim 16 because *De Jong et al.* do not disclose the entire system of amended claim 8, from which claim 16 depends. The mere addition of a wire gauze catalyst support to the reactor of *De Jong et al.* would not make up the differences between Applicant's system of amended claim 8 and the reactor, heat exchanger and desulfurization unit arrangement of *De Jong et al.*, as discussed above with respect to the rejection under 35 U.S.C. § 102(b).

Claims 21, 22, and 24

Claims 21, 22, and 24 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over *De Jong et al.* in view of U.S. Patent No. 5,512,260 (*Kiliany et al.*). Claim 24 has been canceled and its subject matter included in amended claim 8. With respect to claim 21, the Examiner suggests that it would be obvious to provide a gas reactor having feed inlets, a boiler, a condenser, a heater, and a tailgas clean-up unit as described in *Kiliany et al.* as part of a system in *De Jong et al.* With respect to claim 22, the Examiner suggests that it would be obvious to provide a cooler for receiving gas from the tailgas unit and a quench tower as described in *Kiliany et al.* as part of a system in *De Jong et al.* With respect to (now canceled) claim 24, the Examiner suggests that it would be obvious to provide a cooling zone comprising a sulfur condenser as described in *Kiliany et al.* as part of a system in *De Jong et al.* As motivation to combine, the reasons given in the Office Action are (1) it would have been obvious to have provided a system comprising a gas reactor having feed inlets, a boiler, a condenser, a heater, and a tailgas clean-up unit in *De Jong et al.* in order to reduce the sulfur content in a gaseous stream as taught by *Kiliany et al.*; (2) it would have been obvious to provide a cooler for receiving gas from the tailgas unit, and a quench tower

in *De Jong et al.* in order to cool and quench the tailgas product as taught by *Kiliany et al.*; and (3) it would have been obvious to provide a cooling zone that has a sulfur condenser in *De Jong et al.* in order to condense sulfur out of the product gas.

As discussed above, *De Jong et al.* do not teach or suggest that gaseous elemental sulfur is produced in the syngas reactor and emerges from the reactor together with syngas. Neither does *De Jong et al.* teach or suggest condensing elemental sulfur from the reactor effluent prior to further processing of the synthesis gas. Clearly, there is no sulfur condenser in the assembly employed by *De Jong et al.* *Kiliany et al.* disclose apparatus for performing a process in which a sour gas stream is first subjected to an absorption treatment. The resulting hot, cleaned gas (methane) stream 30 is either used to heat a steam boiler or is routed to a chimney or stack 103. In any case, it does not appear that the methane component of the initial gas stream is mixed with H_2S and used for the production of synthesis gas. The absorbed H_2S (plus some CO_2) recovered from the absorption liquid is then treated in a Claus plant, elemental sulfur is removed by condensation, and the Claus tailgas is finally subjected to a catalytic direct oxidation reaction followed by condensation and removal of more elemental sulfur.

The prior art references cited by the Examiner must be considered in their entirety, including portions that would lead away from the claimed invention (*W.L. Gore & Associates, Inc. v. Garlock, Inc.*, 721 F.2d 1540, 220 USPQ 303 (Fed. Cir. 1983), *cert. denied*, 469 U.S. 851 (1984)). The mere fact that the feed inlets, boiler, condenser, heater, and tailgas clean-up unit as described in *Kiliany et al.* may be physically combinable with *De Jong et al.* does not render the resultant combination obvious unless the prior art also suggests the desirability of the combination. To fully consider a combination of *De Jong et al.* with *Kiliany et al.*, one would have to consider the Claus plant and hydrogenation reactor preceding the direct oxidation reactor-condenser combination of *Kiliany et al.* For instance, in Fig. 1C of *Kiliany et al.*, sulfur condenser 76 follows oxidation reactor 74. However, the H_2S feed to reactor 74 comes from a succession of burners 62, 70 and a hydrogenation reactor 61. As mentioned above, the methane component of the sour gas feed in *Kiliany et al.* is not mixed with the H_2S feed to the reactor 74, but is instead burned or exhausted. The reactor 74 of *Kiliany et al.* produces gaseous elemental sulfur, whereas the reactor of *De Jong et al.* does not appear to do so. Neither of these references provides the necessary suggestion or motivation to combine as proposed by the Examiner. Moreover, excising various elements from different stages of the process of *Kiliany et al.* (e.g., heater 40 from the absorbent stage in Fig. 1A; condenser 76 from the direct oxidation stage of Fig. 1C; cooling column (quench

tower) 65 from the hydrogenation stage of Fig. 1C; and a tailgas clean-up unit from Fig. 1A and Fig. 1B) for combination with *De Jong et al.*, while disregarding the other elements of *Kiliany et al.* and *De Jong et al.* that are essential to the purposes for which those different constructions were designed, suggests the use of impermissible hindsight to piece together something resembling the system of Applicant's claims 21 and 22. MPEP § 2142.

The assembly for carrying out the direct oxidation stage described in *Kiliany et al.* is not suitable for use with a light hydrocarbon feed (such as natural gas) that contains H_2S . One reason is that the hydrocarbons would be combusted in the burners. Therefore, one of ordinary skill in the art at the time of the invention would not be inclined to combine the apparatus of *Kiliany et al.* with the apparatus of *De Jong et al.* because they are drawn to different processes using different apparatus. Furthermore, since *De Jong et al.* do not teach or suggest condensing elemental sulfur from the syngas reactor effluent, and since *Kiliany et al.* do not teach or suggest that synthesis gas is produced by their direct oxidation reactor, there is no basis for even trying to combine these references as proposed by the Examiner. Hence, with respect to claims 21 and 22, Applicant respectfully requests that the Examiner reconsider and withdraw the rejection of these claims.

Claims 26-28

Claims 26-28 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over *De Jong et al.* in view of U.S. Patent No. 5,676,921 (*Heisel et al.*). With respect to claim 26, the Examiner suggests that it would be obvious to provide a means for recovering elemental sulfur as described in *Heisel et al.* for the process of *De Jong et al.* With respect to claim 27, the Examiner suggests that *De Jong et al.* provide a means for removing sulfur from synthesis gas product stream. With respect to claim 28, the Examiner suggests that *De Jong et al.* provide a means for maintaining temperature in the reaction zone above $500^{\circ}C$.

Applicant respectfully traverses these rejections and refers to earlier arguments addressing the § 102(b) rejection over *De Jong et al.* and the § 103(a) rejection over *De Jong et al.* in combination with *Kiliany et al.* With respect to claim 26, it is plain from the foregoing discussion and a fair reading of the reference that *De Jong et al.* do not disclose a means for effecting both the catalytic partial oxidation of a light hydrocarbon and the catalytic partial oxidation of H_2S in a single reaction zone. There has been no showing that each and every limitation of claim 26 is contained in the combined references. It should be noted that the Examiner has not pointed to an instance in the *De Jong et al.* reference that provides a means for effecting the catalytic partial oxidation of H_2S , much less in the same reaction zone as the catalytic partial oxidation of

hydrocarbon. *Heisel et al.* also gives no indication that the direct oxidation of H_2S is carried out in the same reaction zone as the catalytic partial oxidation of hydrocarbon. In fact, *Heisel et al.* teach away from such a combination. For example, at Col. 5, lines 28-32, it is stated that reactor temperatures in excess of about $300^\circ C$ lead to undesirable combustion of the H_2S :

"When the temperature exceeds approximately $300^\circ C$, instead of the oxidation of the H_2S into elemental sulfur, the undesirable combustion of the H_2S begins ..."

By contrast, *De Jong et al.* teach that "under the conditions of high pressure prevailing in the process, it is necessary to allow the feed gases to contact the catalyst at elevated temperatures" (Col. 5, lines 44-54.) Suggested temperatures are in the range of $950^\circ C$ to $1300^\circ C$. One of skill in the art would be disinclined to draw from the teachings of *Heisel et al.* when devising a means for the catalytic partial oxidation of light hydrocarbons. For the sake of argument, even if a means for recovering elemental sulfur (i.e., sulfur condenser) as taught by *Heisel et al.* were to be combined with the assembly of *De Jong et al.*, one of skill in the art would more likely be led to try to substitute the reactor and the sulfur condenser of *Heisel et al.* for the desulfurization unit described by *De Jong et al.* at Col. 8, lines 21-27.

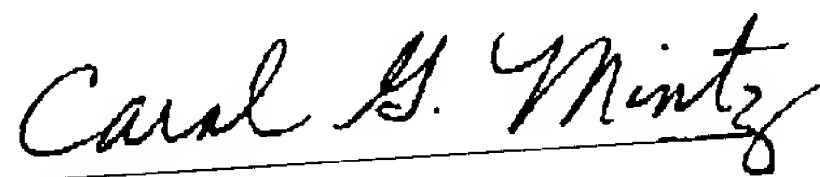
Moreover, because *Heisel et al.* emphasize the importance of keeping the reactor temperature below about $300-400^\circ C$ to avoid combustion of H_2S to SO_2 , it constitutes a teaching away from combination with *De Jong et al.*, which is said by the Examiner to disclose a means for maintaining the temperature of the reaction zone above $500^\circ C$. One of skill in the art would not be motivated to combine these incompatible teachings when seeking to design an efficient system for producing synthesis gas in a short contact time reactor. The combined references do not provide the "means for effecting both the catalytic partial oxidation of a light hydrocarbon to form CO and H_2 products and the catalytic partial oxidation of H_2S to elemental sulfur and H_2O in a single reaction zone of a short contact time reactor." Therefore, Applicant respectfully requests that the Examiner reconsider and withdraw the rejection of claims 26-28.

Conclusion

Applicant may have at times referred to claim limitations in shorthand fashion, or may have focused on a particular claim element. This discussion should not be interpreted to mean that the other limitations can be ignored or dismissed. The claims must be viewed as a whole, and each limitation of the claims must be considered when determining the patentability of the claims. Moreover, it should be understood that there may be other distinctions between the claims and the prior art, which have yet to be raised, but which may be raised in the future.

Consideration of the foregoing amendments and remarks, reconsideration of the application and withdrawal of the rejections and objections is respectfully requested by Applicant. No new matter is introduced by way of the amendments. It is believed that each ground of rejection raised in the Final Office Action dated July 31, 2002 has been fully addressed. However, if a telephone conference would facilitate the resolution of any issue, the Examiner is invited to telephone the undersigned at (713) 238-8000. If any fee is due as a result of the filing of this paper, please appropriately charge such fee to Deposit Account Number 03-2769.

Respectfully submitted,



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AGENT FOR APPLICANT

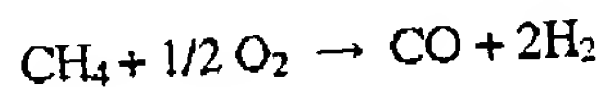
MARKED-UP VERSION OF THE AMENDMENTS

8. (Twice Amended) A system for the partial oxidation of light hydrocarbons and the partial oxidation of H_2S , comprising a hydrocarbon injection line, an H_2S injection line in communication with said hydrocarbon injection line, an oxygen injection line in communication with said hydrocarbon injection line, a reaction zone receiving gases from said hydrocarbon, H_2S and oxygen injection lines and including a catalyst suitable for catalyzing the partial oxidation of said hydrocarbon and the partial oxidation of H_2S to form a product comprising CO , H_2 , elemental sulfur and H_2O , and, downstream from said reaction zone, at least one cooling zone including a sulfur condenser for removing elemental sulfur from said product.

15. (Amended) The system according to claim ~~14~~8 comprising at least one tailgas processing unit downstream of said ~~cooling zone~~sulfur condenser.

17. (Amended) The ~~method system~~ according to claim 8 wherein the catalyst is selected from the group consisting of: platinum, rhodium, iridium, nickel, palladium, iron, cobalt, rhenium, rubidium, $Pd-La_2O_3$, Pt/ZrO_2 , Pt/Al_2O_3 and combinations thereof.

23. (Amended) The system of claim ~~8-17~~ wherein said catalyst is active for catalyzing the reactions



and

